The Next Comfort Zone: Re-engineering Building HVAC Operations for Direct Air Capture Technologies

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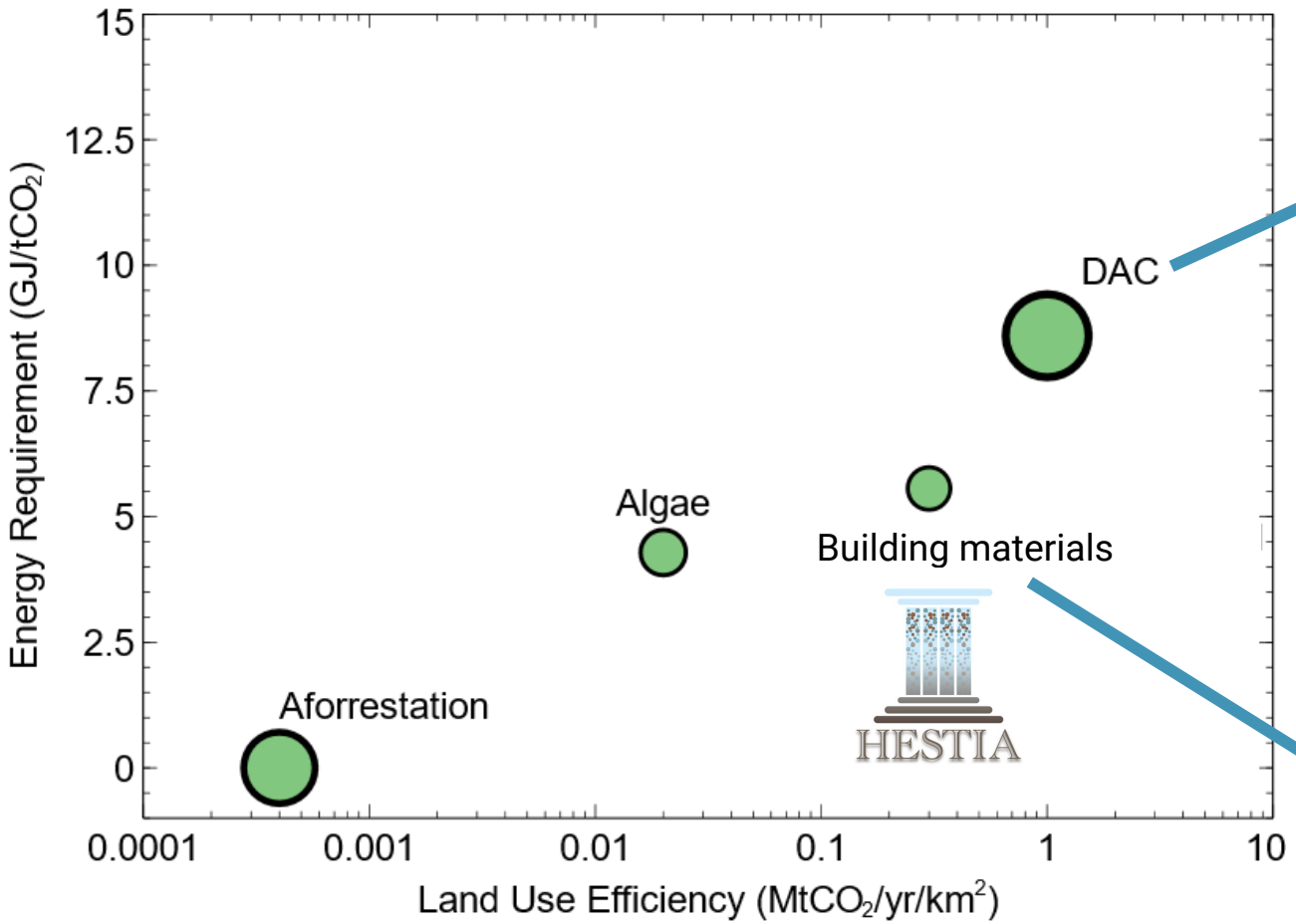
Reinventing the efficiency drivers for the built environment



Data from:
Srubar III, W.V. "Can We Grow Carbon-Storing Buildings?" in *Build Beyond Zero: New Ideas for Carbon-Smart Architecture.* B. King & C. Magwood, Eds. In press;
BNEF; ARPA-E MARINER program; carbonplan.org

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Going beyond HVAC retrofit strategies

FAST COMPANY

08-13-21

This startup uses the cooling towers on buildings as carbon capture devices

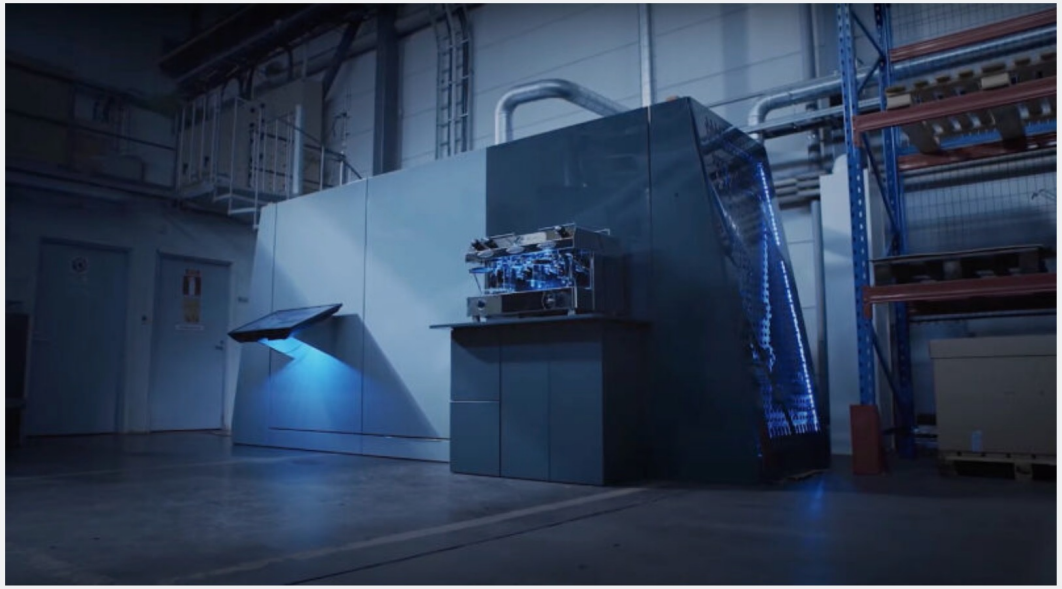
Direct air capture machines are expensive to build, making the economics of carbon capture difficult to pencil out. But Noya wants to use existing infrastructure instead.

ars TECHNICA

This machine takes office-air CO_2 and turns it into fuel

Finnish Soletair Power markets carbon capture as indoor air quality control.

SCOTT K. JOHNSON - 10/13/2020, 12:42 PM

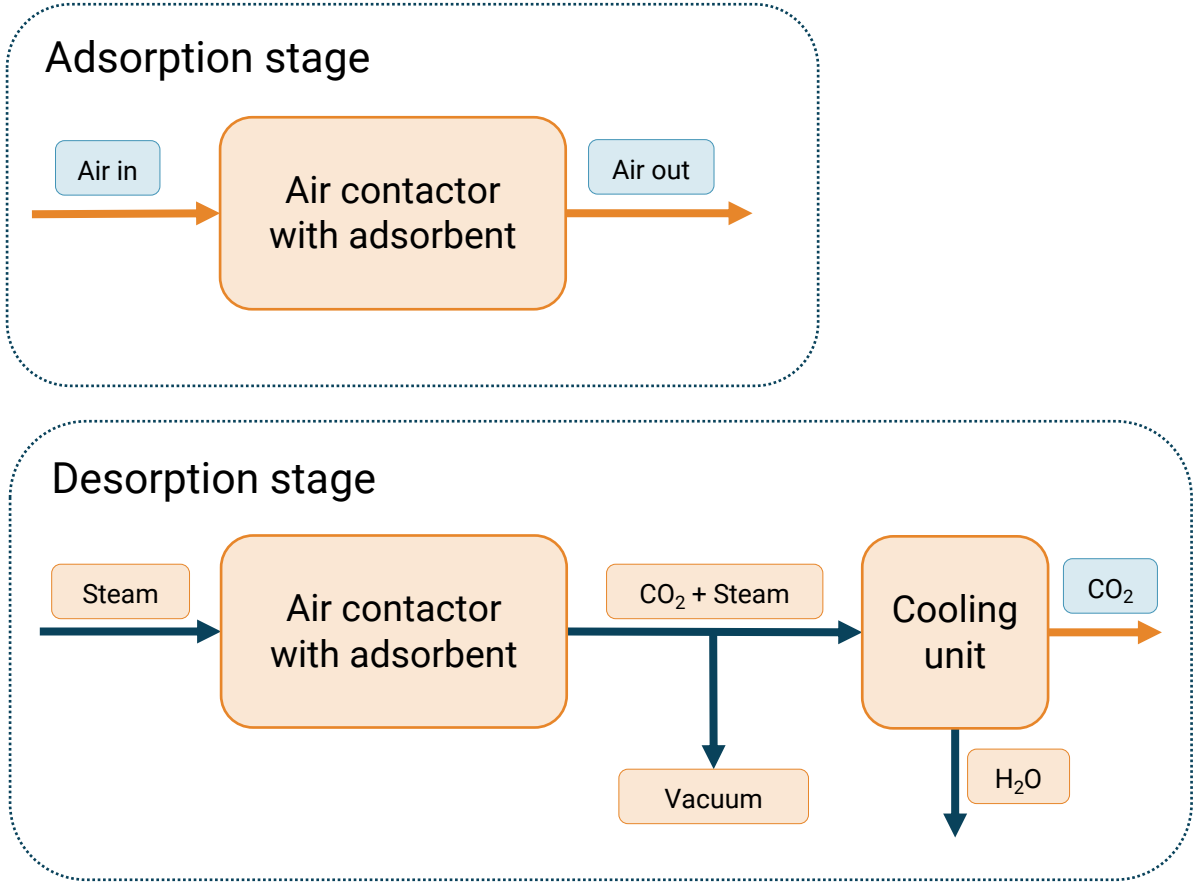


Soletair Power

Enlarge / This is Soletair's demonstration unit. Air goes in, fuel comes out. (Espresso machine optional.)

How can HVAC operations be optimized through an integrated, co-designed system?

Integration requirements



- High enough temperatures
- Optimized air flow
- Acceptable selectivity & stability
- Suitability for indoor environments

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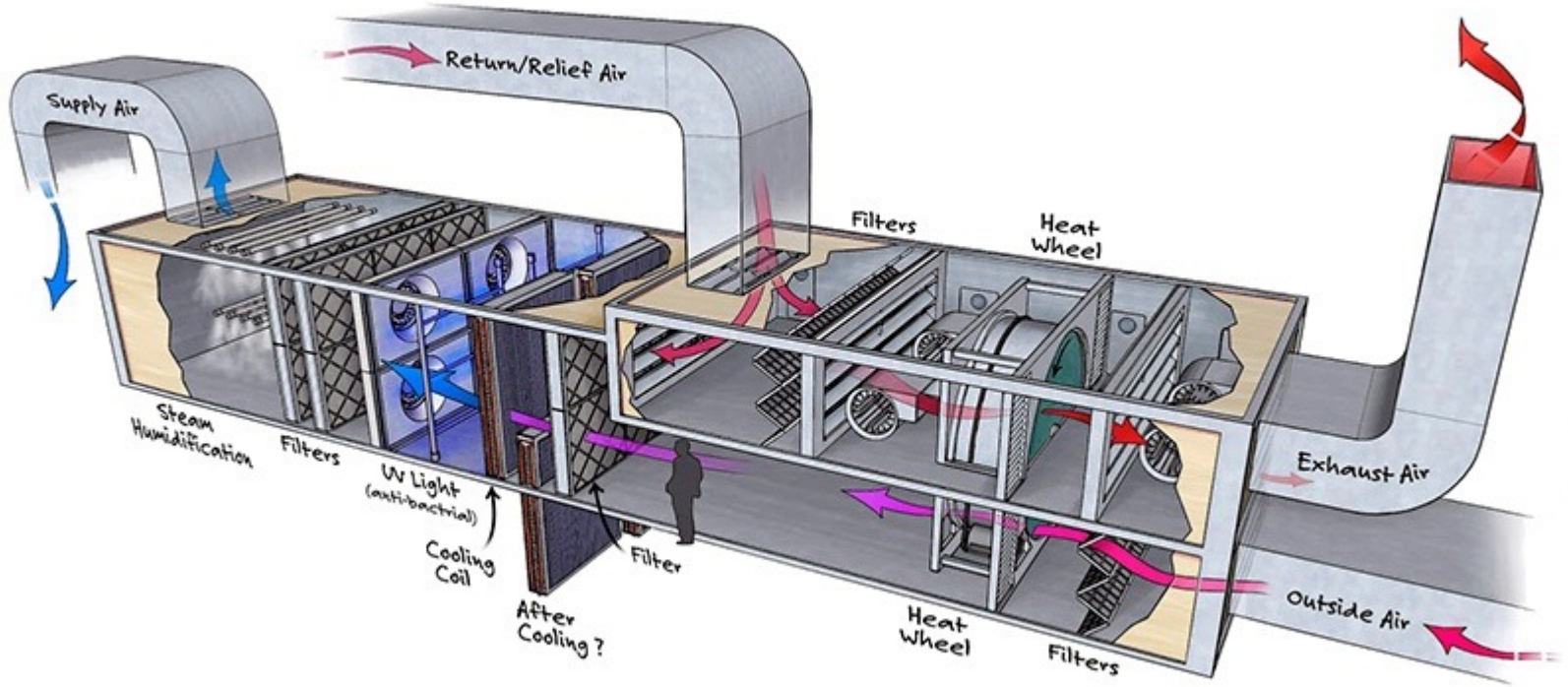
Sources: National Academies of Sciences, Engineering, and Medicine. "Negative emissions technologies and reliable sequestration: a research agenda." (2018)

Leveraging ventilation capacity

- ANSI/ASHRAE Standard 62.1: Ventilation for Acceptable Indoor Air Quality

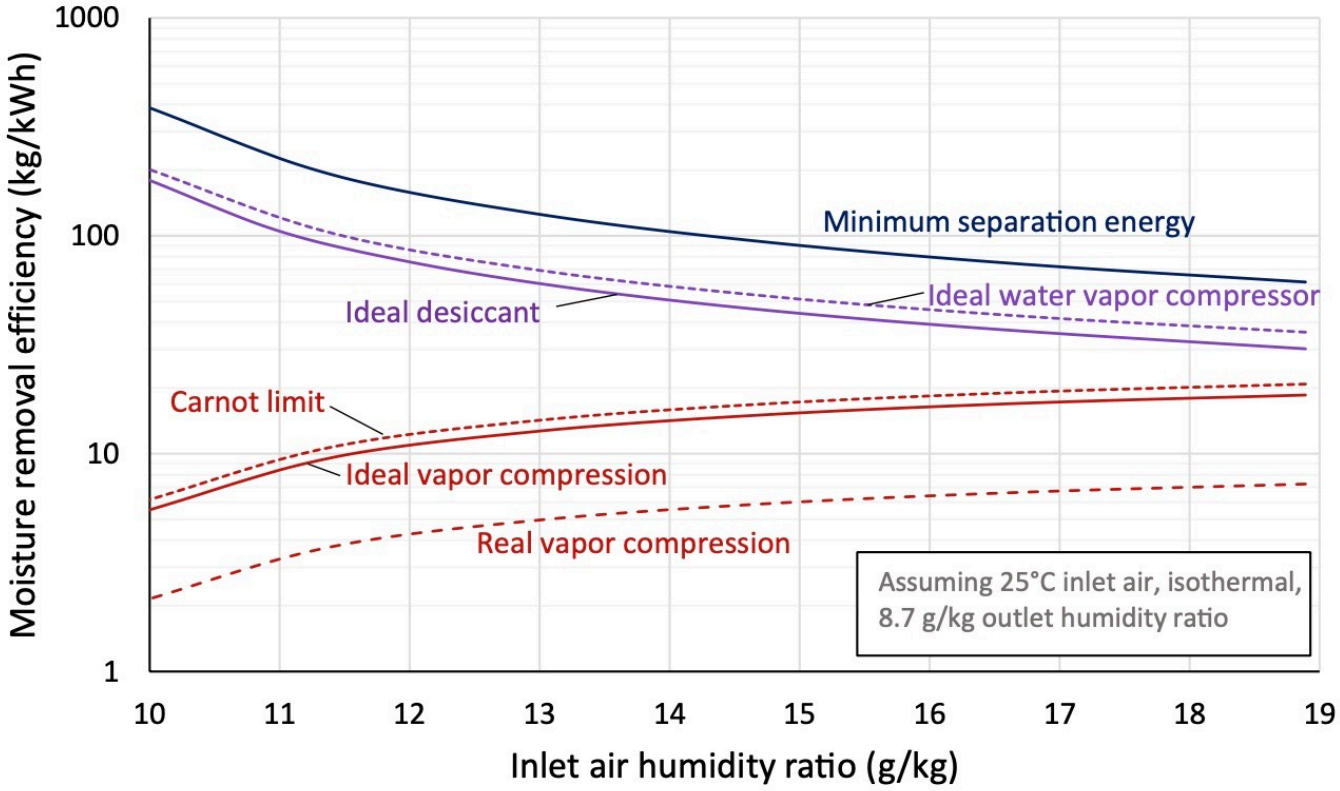
- Air Changes per Hour:

$$ACH = \frac{CFM \times 60}{Area \times Height_{ceiling}}$$



An opportunity to remove water vapor from air more efficiently

- **Humidity loads ~**
  600 $MtCO_2eq$ or **1/3** of annual HVAC emissions & growing
- **Moisture removal efficiency ~**
  potential **10x** improvement with new separation processes
- **Temperature loads ~**
  improved cooling efficiency can also expected



Source: Rivest et al., Joule 6, 726-741, 2022.

How can moisture removal efficiency be improved with a co-designed DAC approach?

Shaping our building operations for a negative emissions future

- How is a market for DAC integrated into future HVAC systems structured?

- How is future infrastructure built out for utilizing and/or transporting captured CO_2?

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Attend Coffee w/ ARPA-E
Tomorrow 7:45-8:45 am @ Juniper Ballroom

and/or

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https://arpa-e.energy.gov